ON OPTIMIZATION OF HYDROGEN PRODUCTION DURING COMBUSTION OF ALUMINUM NANOPOWDER IN STEAM*

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Abstract: The paper presents the results of numerical simulation of the process of molecular hydrogen production during the combustion of aluminum nanopowder in steam. The calculations are carried out on the basis of a previously developed combustion model of an ensemble of aluminum nanoparticles in steam. As a result of calculations, the time histories of mixture temperature and concentrations of components, including molecular hydrogen, are found at different values of the initial conditions (temperature, radius of aluminum particles and the presence of an oxide film on them, and the ratio of initial concentrations of aluminum and water). The effect of small oxygen additives on the combustion process has also been studied. The obtained data allow one to find conditions for achieving the maximum degree of conversion of steam into molecular hydrogen at optimal thermophysical parameters of combustion products.

Keywords: aluminum; nanoparticles; combustion; steam; hydrogen

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Figure Captions

Figure 1 Predicted time histories of the reacting mixture temperature (*a*) and molar fractions of molecular hydrogen (*b*) at different values of the initial temperature T_0: *1* — 2300 K; and *2* — 2500 K

Figure 2 Predicted dependence of the water conversion coefficient on the initial ratio of aluminum and water concentrations: *1* — γ; and *2* — $\gamma_{\max}$

Figure 3 Predicted time histories of the reacting mixture temperature (*a*) and molar fractions of molecular hydrogen (*b*) at different values of the initial content of small oxygen additives to the mixture: *1* — 0% O_2; *2* — 1% O_2; *3* — 2% O_2; and *4* — 3% O_2

Table Captions

Table 1 Some basic parameters of the reacting mixture at two different initial values of temperature

Table 2 Some basic parameters of the reacting mixture at different values of the thickness of the initial oxide layer on Al particles

Table 3 Some basic parameters of the reacting mixture at different values of the initial ratio of aluminum and water concentrations

Table 4 Some basic parameters of the reacting mixture at different values of small oxygen additives to the reacting mixture

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